ORIGINAL ARTICLE

Knowledge, attitude, practice, and toxicity symptoms associated with pesticide use among farm workers in the Gaza Strip

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The questionnaire can be viewed on the OEM website

Aims: To assess knowledge, attitude, practice, and toxicity symptoms associated with pesticide use and exposure among 189 farm workers in the Gaza Strip.
Methods: A cross section of agricultural farm workers in the Gaza Strip were asked to fill in a questionnaire on knowledge, attitudes, practice towards pesticide use, and associated toxicity symptoms.
Results: Farm workers reported high levels of knowledge on the health impact of pesticides (97.9%). Moderate to high levels of knowledge were recorded on toxicity symptoms related to pesticides. Most farm workers were aware of the protective measures to be used during applying pesticides. However, no one took precautions unless they knew about the measures. Burning sensation in eyes/face was the commonest symptom (64.3%). The prevalence of self reported toxicity symptoms was dependent on mixing and use of high concentrations of pesticides. The highest percentage of self reported toxicity symptoms was found among the farm workers who returned to sprayed fields within one hour of applying pesticides.
Conclusions: Farm workers in the Gaza Strip used pesticides extensively. Despite their knowledge about the adverse health impact of the pesticides, the use of protective measures was poor. Most had self reported toxicity symptoms, particularly the younger workers. It would be useful to minimise the use of pesticides and encourage alternative measures. Prevention and intervention programmes regarding the use of protective measures and monitoring the health status of farm workers should be implemented.

The Gaza Strip is an elongated area located in a semi-arid region. It is bordered by Egypt from the south, the Negev Desert from the east, and the Mediterranean Sea from the west. The total surface area of the Gaza Strip is 365 km^2 and its population is estimated to be more than one million people.[1] The main crops grown include citrus fruits, olives, almonds, grapes, other subtropical fruits, vegetables, and flowers.[2] More than 250 metric tons of formulated pesticides, mainly insecticides and fungicides, in addition to one thousand metric tons of methyl bromide, are used annually in the Gaza Strip. Some of these pesticides have been internationally suspended, banned, or cancelled because of their mutagenicity, teratogenicity, or carcinogenicity.[3–5] Under the Montreal Protocol methyl bromide is considered to be an ozone depleting substance; it will be phased out in 2005 for industrialised countries and in 2015 for developing countries.[6]

Several cases of chronic toxicity or death have been reported and proven among farm workers exposed to different types of pesticides in the Gaza Strip and other developing countries. This may be a result of the use or misuse of these highly toxic compounds, where precautions regarding wearing protective gear during handling and application are poorly followed.[2–5 7–10] However, the use of pesticides is unavoidable, particularly in a very densely populated area with low income such as the Gaza Strip.

The main aim of the present study was to assess knowledge, attitude, and practice towards pesticides, and self reported toxicity symptoms related to pesticide exposure among farm workers applying pesticides in the Gaza Strip with the following specific objectives:

(1) Assessment of the knowledge of farm workers regarding pesticide effects, their route of entry into the body, self reported toxicity symptoms, and the use of protective gear as well as determination of their attitude towards pesticides.
(2) Evaluation of work practices regarding the use of protective measures and activities with potential for exposure to pesticides.
(3) Identification of self reported toxicity symptoms associated with pesticide exposure and their relation to work practices.

SUBJECTS AND METHODS

The investigation was a cross sectional study. The target population was agricultural farm workers in the Gaza Strip working in open or closed fields, or both, and applying pesticides during the summer of 1999.

The estimated number of agricultural farmers using pesticides in the Gaza Strip was 9 out of 10 (personal communication with Ministry of Agriculture, Palestinian National Authority). The sample size was determined in order to have 95% confidence limits of 5% maximum error of the estimate, when the prevalence is 90%.[11] This leads to a requirement of 138 farm workers. For a no-response expectation, the sample size was increased to 200 farm workers.

A stratified sample was used; the Gaza Strip was divided geographically into five Governorates: Northern, Gaza, Mid Zone, Knan Younis, and Rafah. The Palestinian Ministry of Agriculture estimated the number of agricultural farmers as 15 000 in Gaza Governorates, distributed as follows: Northern (3000), Gaza (2000), Mid Zone (3000), Khan Younis (4500), and Rafah (2500). Therefore, the sample size of 200 farm workers was distributed according the number of farmers in each Governorate as follows: Northern (40), Gaza (27), Mid Zone (40), Khan Younis (60), and Rafah (33).

Table 1 The response of farm workers (n=200) selected from different Governorates of the Gaza Strip

	Farm workers		
Governorate	Sample size	No. of respondents	%
Northern	40	38	95.0
Gaza	27	26	96.3
Mid Zone	40	40	100.0
Khan Younis	60	56	93.3
Rafah	33	29	87.9
Total response	200	189	94.5

A meeting interview was used for filling in the questionnaire. All interviews were conducted face to face by one investigator who had a Masters degree of public health and is familiar with farm workers.[12] The questionnaire was based on United States Environmental Protection Agency questions, and on that used in a similar study with few modifications.[13 14] Most questions were one of two types: the yes/no question, which offers a dichotomous choice; and the multiple choice question, which offers several fixed alternatives.[15] A questionnaire was piloted with 10 farm workers not included in the sample from the study area, and modified as necessary.

The questionnaire included questions related to: background information, for example, area, age, education, and marital status; the health impact of exposure to pesticides (self reported toxicity symptoms associated with pesticides use); knowledge of the acute and chronic toxicity of pesticides, prohibited pesticides, effect of pesticides on human health, other alternatives to pesticides, the route of pesticide entry into the human body, and names of pesticides used; and attitudes regarding the use of pesticides and protective equipment or clothes during preparation and application of pesticides. Practice questions included: the wearing of protective clothes; following label instructions and agronomist guiding; re-entry period in the farm after applying pesticides; smoking, eating, drinking water, or chewing gum during application of pesticides; whether to have a water bath or not after application; and whether they complied with the safety period and concentration recommended, either by the agronomist or by the pesticide label. The sample of 200 subjects was selected randomly from different locations in each subarea. The farm workers who did not meet the criterion of being involved in applying pesticides during the summer of 1999, were excluded and replaced by those who did meet the criteria.

Data were analysed by computer using the SPSS/PC (Statistical Package for the Social Sciences Inc., Chicago, Illinois) and EPIINFO (Epidemiological Program Office, CDC, Atlanta, Georgia) statistical packages. Simple distribution of the study variables, the cross tabulation, and normal χ^2 tests were applied. Yates's continuity correction test, $\chi^2_{(corrected)}$, was used when not more than 20% of the cells had an expected frequency of less than five and when the expected numbers were small. The χ^2 test for trend, $\chi^2_{(trend)}$ with 1 df, which is a more sensitive test that looks for an increasing (or decreasing) trend in the proportions over the columns having natural order, was used.[16 17] These tests were used to identify the significance of the relations, associations, and interactions among knowledge, attitude, practice towards pesticides, and the prevalence of self reported toxicity symptoms.

RESULTS

The total response for the questionnaire interview was 94.5% (n = 189). Table 1 shows that the highest response among the farm workers was found in the Mid Zone Governorate (100%, n = 40) and the lowest response in Rafah Governorate (87.9%, n = 29). The average age of the respondent farm workers (n = 189) was 32.4 (0.8) years old.

Analysis of the educational status of the respondent farm workers (n = 189) showed that 25 (13.2%) had a university degree, 81 (42.9%) had finished secondary school, 42 (22.2%) had finished preparatory school, 25 (13.2%) had passed primary school, and 16 (8.5%) were illiterate. A total of 139 (73.5%) were married; only seven (5.0%) had no children. In addition, 64 (33.9%) were smokers.

The questions related to the type of agricultural field and planted crops illustrated that 109 (57.7%) were growing their crops in both open and closed fields, 59 (31.2%) were growing their crops in open fields, and 21 (11.1%) were growing their crops in closed fields. Vegetables was the crop grown by most farm workers (n = 173, 91.5%), followed by fruits (n = 57,

Table 2 Knowledge of the respondent farm workers regarding name, health effects, biological and natural controls, route of pesticide entry into body, and fate of pesticide residues

	Farm workers with knowledge		
Items	Sample size	Frequency	%
Name of the pesticides used			
Knowing the name of pesticides used	189	183	96.8
Health effect of pesticides			
Knowing the adverse health effects of pesticide exposure on human health	189	185	97.9
Knowing not all pesticides have the same adverse health effects	185	155	83.8
Biological and natural control			
Knowing biological control	189	23	12.2
Knowing natural control	189	36	19.0
Route of pesticide entry into body			
Inhalation (nose)	189	176	93.1
Skin	189	167	88.4
Mouth	189	166	87.8
Fate of pesticide residues			
Air	189	113	59.8
Soil	189	126	66.7
Groundwater	189	80	42.3
Leaves and fruits of vegetables and fruits	189	103	54.5

Table 3 Knowledge of toxicity symptoms among farm workers (n=185)* in the Gaza Strip

Symptoms	Farm workers with knowledge of toxicity symptoms No. (%)
Headache	153 (82.7)
Burning sensation in eyes/face	177 (95.7)
Weakness	128 (69.2)
Fever	106 (57.3)
Watering eyes	163 (88.1)
Skin rash	127 (68.6)
Itching and skin irritation	157 (84.9)
Dizziness	152 (82.2)
Cold/breathlessness/chest pain	158 (85.4)
Forgetfulness	49 (26.5)
Loss of libido	52 (28.1)
Salivation and vomiting	141 (76.2)
Abdominal pain/diarrhoea	134 (72.4)

*Only 185 farm workers, who did know the adverse health effects of pesticides, were questioned.

30.2%), citrus fruits (n = 30, 15.9%), and flowers (n = 12, 6.3%). In addition, 65 (34.4%) farm workers reported that the agronomists were visiting their farms periodically. Those agronomists came from the Ministry of Agriculture and the Palestinian Agricultural Relief Committee.

Knowledge of farm workers about pesticides

Table 2 illustrates the knowledge of the respondent farm workers (n = 189) regarding the name, health effects, biological and natural controls, route of pesticide entry into the body, and the fate of pesticide residues. A total of 185 (97.9%) farm workers had knowledge about the adverse health effects of pesticides on human health. When those farm workers were questioned further about the degree of health impact of pesticides, a total of 155 (83.8%) knew that not all pesticides have the same adverse health effects. It was also found that 183 (96.8%) knew the name of the pesticides they were using. A total of 23 (12.2%) and 36 (19.0 %), respectively, knew biological and natural control as alternatives to pesticides for pest control. Table 2 also presents the possible routes of exposure to pesticides known by the respondent farm workers; 176 (93.1%) farm workers claimed that inhalation is the route of entry, followed by 167 (88.4%) who reported that skin is the route of entry, and 166 (87.8%) who claimed that the mouth is the route of entry of pesticides into the body. In terms of knowledge regarding the fate of pesticide residues, the highest number (n = 126, 66.7%) reported that pesticide residues may be detected in the soil, whereas the lowest frequency (n = 80, 42.3%) reported that pesticide residues may be detected in the groundwater.

Table 3 shows that the toxicity symptoms best known were a burning sensation in the eyes/face (n = 177, 95.7%), watering eyes (n = 163, 88.1%), cold/breathlessness/chest pain (n = 158, 85.4%), itching and skin irritation (n = 157, 84.9%), headache (n = 153, 82.7%), and dizziness (n = 152, 82.2%). The toxicity symptoms least known were loss of libido (n = 52, 28.1%) and forgetfulness (n = 49, 26.5%).

Table 4 illustrates the knowledge of farm workers (n = 185) about protective gear. A total of 167 (90.3%) farm workers had information that gloves can protect skin of the hands from the adverse health effects of pesticides, while a total of 163 (88.1%) reported that goggles can protect the eyes from the adverse effects of pesticides. A total of 169 (91.4%) believed that wearing a wide brimmed hat and special boots can protect the head and feet from pesticides. A total of 180 (97.3%) admitted that wearing an oral–nasal mask can prevent entrance of the pesticide drifts through the mouth or nose into the human body. A total of 177 (95.7%) reported that wearing protective gear as overalls can protect the whole body. The interaction between use of protective measures and awareness of farm workers towards these measures showed that most farm workers were aware of the protective measures to be used during application of pesticides, but no one took precautions unless they knew about the measures.

Attitudes of farm workers towards pesticides

A total of 112 (59.3%) farm workers (n = 189) were against the use of pesticides for pest control. They justified the use of pesticides by the absence of other successful alternatives for pest control. On the other hand, a total of 77 (40.7%) reported that use of pesticides is the best and most efficient way for pest control.

In term of body resistance to pesticides, a total of 125 (67.6%) farm workers (n = 185) believed that their body has developed resistance to pesticides, whereas 60 (32.4%) had the opposite opinion.

Table 4 Frequency and percentage of farm workers (n=185)* who used protective measures by their knowledge about those measures

Protective measures in use	Have knowledge No. (%)	Have no knowledge No. (%)	p value†
Wear gloves (n=167)			
Yes	37 (22.2)	0 (0.0)	0.06
No	130 (77.8)	18 (100)	
Wear goggles (n=163)			
Yes	15 (9.2)	0 (0.0)	0.28
No	148 (90.8)	22 (100)	
Wear wide brimmed hat (n=169)			
Yes	23 (13.6)	0 (0.0)	0.24
No	146 (86.4)	16 (100)	
Wear oral–nasal mask (n=180)			
Yes	41 (22.8)	0 (0.0)	0.50
No	139 (77.2)	5 (100)	
Wear special boots (n=169)			
Yes	28 (16.6)	0 (0.0)	0.16
No	141 (83.4)	16 (100)	
Wear overalls (n=177)			
Yes	35 (19.8)	0 (0.0)	0.40
No	142 (80.2)	8 (100)	

*Only 185 farm workers, who did know the adverse health effects of pesticides, were questioned; †p value of $\chi^2_{(corrected)}$ test.

Table 5 Pesticides known by farm workers (n=183)* as "frequently used" during summer season (1999) in the Gaza Strip

Agricultural pesticides	Farm workers who reported use of pesticides No. (%)
Insecticides	
Organophosphorus	
Methamidophos	109 (59.6)
Chlorpyrifos	75 (41.0)
Fenamiphos	20 (10.9)
Dimethoate	16 (8.7)
Dichlorovos	6 (3.3)
Oxydemetonmethyl	3 (1.6)
Azinophosmethyl	2 (1.1)
Carbamate	
Methomyl	44 (24.0)
Carbosulphan	19 (10.4)
Pyrethroids	
Cypermethrin	74 (40.4)
Fenpropathrin	61 (33.3)
Cyhalothrin	9 (4.9)
Organochlorine	
Endosulphan	86 (47.0)
Other groups	
Abamectin	37 (20.2)
Thiocalm hydrogen oxalate	30 (16.4)
Imidaclopride	28 (15.3)
Chlorfluazuron	21 (11.5)
Bromopyalate	6 (3.3)
Fungicides	
Mancozeb	116 (63.4)
Penconazole	41 (22.4)
Triadimenol	27 (14.8)
Maneb	23 (12.6)
Propineb	19 (10.4)
Copper oxychloride	15 (8.2)
Benomyl	10 (5.5)
Propamocarb HCl	8 (4.4)
Chlorothalonil chlorotaluran	7 (3.8)
Pyrazophos	6 (3.3)
Captan	6 (3.3)
Fumigants	
Methyl bromide	12 (6.6)
Other pesticides†	18 (9.8)

*Only 183 farm workers, who did know the names of pesticides they used, were questioned.
†Other pesticides: clofentenine, pirimicarb, fenazaquin, ametraz, cyfluthrin, methalaxyle, fenarimol, glyphosate, and bifenthrin.

Table 6 Storage of pesticides and fate of empty containers as reported by farm workers (n=189)

Variable	Farm workers No. (%)
Storage of pesticides	
On the farm site	149 (78.8)
In the home	34 (18.0)
Fate of empty containers	
Home use	0 (0.0)
Storage of other pesticides	2 (1.1)
Throw on garbage site or along the street	122 (64.6)
Burying or burning	85 (45.0)

Table 7 Farm workers (n=189) who reported almost always using protective measures during application of pesticides

Protective measures in use	Farm workers No. (%)
Wear gloves	37 (19.6)
Wear goggles	15 (7.9)
Wear wide brimmed hat	23 (12.2)
Wear oral–nasal mask	41 (21.7)
Wear special boots	28 (14.8)
Wear overalls	36 (19.0)
Have water bath after application	102 (54.0)
Not smoking during application	168 (88.9)
Not eating during application	154 (81.5)
Not drinking during application	131 (69.3)
Not chewing gum during application	183 (96.8)

Practices towards pesticides

All interviewed farm workers (n = 189) used pesticides; 183 knew the name of the pesticides they used. Table 5 lists the types and names of pesticides that were frequently used during the summer of 1999 in the Gaza Strip. The most common insecticides were organophosphates, carbamates, pyrethroids, and organochlorines. Other types of agricultural pesticides used included fungicides and fumigants.

The distribution of organophosphorus insecticide use was as follows: Northern (n = 27, 71.1%), Gaza (n = 24, 92.3%), Mid Zone (n = 33, 82.5%), Khan Younis (n = 41, 73.2%), and Rafah (n = 19, 65.5%).

Table 6 shows that 149 (78.8%) farm workers stored pesticide containers on the farm, whereas 34 (18.0%) stored them in the home. In addition, 122 (64.6%) threw the empty pesticide containers on the garbage site or along the street, while 85 (45.0%) buried or burned them.

Table 7 lists the different protective measures regularly used by farm workers (n = 189) during application of pesticides. The highest number (n = 41, 21.7%) wore oral–nasal masks and the lowest number (n = 15, 7.9%) wore goggles during preparation and application of pesticides. The numbers of farm workers who mentioned not drinking, not eating, not smoking, and not chewing gum during application of pesticides were 131 (69.3%), 154 (81.5%), 168 (88.9%), and 183 (96.8%), respectively. Moreover, 102 (54.0%) had a water bath directly after applying pesticides.

The activities of farm workers (n = 189) with potential for exposure to pesticides showed that a total of 106 (56.1%) used the recommended concentration of pesticides; only two (1.1%) did not use specific concentrations. A total of 81 (42.9%) used more than the recommended concentration, but none used less than the recommended concentration. A total of 170 (89.9%) reported that they mixed two or more pesticides before they applied them. Regarding the re-entry period, two farm workers gave no response, 107 (57.2%) re-entered the field within an hour, 63 (33.7%) re-entered during 2–12 hours, and 17 (9.1%) re-entered more than 12 hours after applying pesticides.

Eight farm workers (4.2%) kept first aid equipment, and 29 (15.3%) participated in seminars, training, and other activities related to the hazards of pesticides and their effects on human health. Organisations which conducted these seminars included the Environmental Protection and Research Institute, the Palestinian Agricultural Relief Committee, and the Ministry of Agriculture.

Prevalence of self reported toxicity symptoms related to pesticides

A total of 185 farm workers, who knew the adverse health effects of pesticides, were questioned about toxicity symptoms. The recall period was shortened to three months preceding the interview to minimise the possibility of recall bias. Table 8 lists the prevalence of self reported toxicity symptoms. A total of 154 (83.2%) had self reported toxicity symptoms related to pesticides, with burning sensation in the eyes/face being the most common (n = 119, 64.3%) and forgetfulness the least common (n = 3, 1.6%). However, several cases of poisoning and death associated with pesticide use were recalled by the interviewed farm workers. A total of

Table 8 Prevalence of self reported toxicity symptoms among farm workers (n=185)* in the Gaza Strip

Symptoms	Prevalence of self reported toxicity symptoms experienced in the past 3 months No. (%)
Headache	49 (26.5)
Burning sensation in eyes/face	119 (64.3)
Weakness	10 (5.4)
Fever	6 (3.2)
Watering eyes	35 (18.9)
Skin rash	32 (17.3)
Itching and skin irritation	50 (27.0)
Dizziness	60 (32.4)
Cold/breathlessness/chest pain	52 (28.1)
Forgetfulness	3 (1.6)
Loss of libido	5 (2.7)
Salivation and vomiting	16 (8.6)
Abdominal pain/diarrhoea	18 (9.7)

*Only 185 farm workers, who did know the adverse health effects of pesticides, were questioned.

Table 9 Prevalence of self reported toxicity symptoms among farm works by locality, type of agricultural field, age, and years of using pesticides

Variable	Reported toxicity symptoms No. (%)
Governorate*	
Northern (n=38)	31 (81.6)
Gaza (n=26)	24 (92.3)
Mid Zone (n=40)	29 (72.5)
Khan Younis (n=53)	45 (84.9)
Rafah (n=28)	25 (89.3)
Type of agricultural field†	
Closed field (n=20)	18 (90.0)
Open field (n=59)	46 (78.0)
Open and closed field (n=106)	90 (84.9)
Age group‡	
<25 (n=64)	56 (87.5)
26–36 (n=60)	52 (86.7)
>37 (n=61)	46 (75.4)
Years of using pesticides§	
<10 (n=103)	84 (81.6)
11–20 (n=58)	48 (82.8)
>21 (n=24)	22 (91.7)

*Prevalence of self reported toxicity symptoms *v* area (χ^2=5.75, p=0.22).
†Prevalence of self reported toxicity symptoms *v* type of agricultural field (χ^2=2.04, p=0.36).
‡Prevalence of self reported toxicity symptoms *v* age group (χ^2=4.02, p=0.13).
§Prevalence of self reported toxicity symptoms *v* years of using pesticides ($\chi^2_{(trend)}$=1.08, p=0.29).

58 (31.4%) recalled deaths and 129 (69.7 %) recalled poisoning cases in the Palestinian community in the three years preceding the interview. Moreover, all farm workers (n = 189) reported that there were neither medical nor health care centres which provided medical services or cared for farm workers' health.

Table 9 shows the prevalence of self reported toxicity symptoms among the farm workers. The variation in the prevalence of self reported toxicity symptoms by locality was not significant (χ^2 = 5.75, p = 0.22). The prevalence of self reported toxicity symptoms was higher among farm workers who work in closed agricultural fields (90.0%) than in those who work in open ones (78.0%). Furthermore, the variation in the prevalence of self reported toxicity symptoms by type of agricultural field was not significant (χ^2 = 2.04, p = 0.36).

Table 10 Prevalence of self reported toxicity symptoms among farm workers by pesticide concentration applied, mixing of pesticides, and re-entry period

Variable	Prevalence of self reported toxicity symptoms No. (%)
Pesticide concentration applied*	
Less than recommended (n=2)	1 (50.0)
Recommended (n=103)	80 (77.7)
More than recommended (n=80)	73 (91.3)
Mixing pesticides†	
Mixing two or more pesticides (n=168)	144 (85.7)
Not mixing two or more pesticides (n=17)	10 (58.8)
Re-entry period (hours)‡	
0–1 (n=105)	90 (85.7)
2–12 (n=61)	50 (82.0)
13–24 (n=17)	14 (82.4)
Non-response (n=2)	–

*Prevalence of self reported toxicity symptoms *v* pesticide concentration applied ($\chi^2_{(trend)}$=7.23, p=0.007).
†Prevalence of self reported toxicity symptoms *v* mixing pesticides (χ^2=8, p=0.005).
‡Prevalence of self reported toxicity symptoms *v* re-entry period (χ^2=0.45, p=0.79).

Farm workers were classified into three age groups: <25, 26–36, and >37 years old. The highest self reported toxicity symptoms (87.5%) were found in the <25 years old group and the lowest symptoms (75.4%) were found in the group aged >37 years old. The increase in the prevalence of self reported toxicity symptoms with decrease of age was not significant (χ^2 = 4.02, p = 0.13). Regarding the years of using pesticides, the increase in the prevalence of self reported toxicity symptoms with increasing periods of using pesticides was found not significant ($\chi^2_{(trend)}$ = 1.08, p = 0.29).

As indicated in table 10, the prevalence of self reported toxicity symptoms associated with pesticide exposure among farm workers was correlated with concentration of pesticides used. The prevalence of self reported toxicity symptoms among farm workers who used less, recommended, and more than recommended concentrations of pesticides was 50.0%, 77.7%, and 91.3%, respectively. This increasing trend was found to be statistically highly significant ($\chi^2_{(trend)}$ = 7.23, p = 0.007). In addition, the prevalence of self reported toxicity symptoms was higher in farm workers who mix two or more pesticides (85.7%) than in those who do not mix them (58.8%). Also, the increase in the prevalence of self reported toxicity symptoms as a result of mixing and not mixing pesticides was found to be highly significant (χ^2 = 8, p = 0.005). The highest percentage of self reported toxicity symptoms was found among the farm workers who returned to sprayed fields within one hour of applying pesticides. The association between re-entry period and the prevalence of self reported toxicity symptoms was not significant at 2 degrees of freedom, the 5% level, and χ^2 = 0.45, p = 0.79.

DISCUSSION

The present work was carried out in the Gaza Strip, which has several environmental problems, including concern about the effects of pesticide related activities in the agricultural sector. Pesticide problems have been identified as a major environmental health problem in the Gaza Strip.[2–5 18 19] The present study describes the knowledge, attitude, practice, and toxicity symptoms related to pesticide use among farm workers in the Gaza Strip.

The total response of farm workers to the questionnaire interview was relatively high, indicating good intentions to participate in the present study. The highest response was

found in the Mid Zone Governorate while the lowest response was reported in the Rafah Governorate. This may be attributed to the employment of most farm workers in the Rafah Governorate in greenhouse work during the interview period, whereas most of those in the Mid Zone Governorate work in open fields, making them more available.

A low level of illiteracy was recorded among the respondent farm workers, reflecting a well educated community. This may give the impression that the high rate of educated farm workers is a result of them not getting another job because of the unemployment crisis in the Gaza Strip.

The percentage of the respondent farmer workers who grow their crops under greenhouses beside open fields was higher than those growing their crops in either open or closed fields. The nature of greenhouses favours the appearance of plagues, and therefore the extensive use of pesticides, which put the farm workers at high risk.[20] The finding that the highest percentage of farm workers in the Gaza Strip grows vegetables will also put them at risk.

Knowledge of the respondent farm workers in the Gaza Strip about the effects of pesticides on human health was relatively accurate, a finding inconsistent with a study from the Netherlands.[21] Knowledge of the names of pesticides used was also relatively accurate, whereas knowledge concerning biological and natural control was low. This necessitates the launch of educational extension programmes on pesticide alternatives among farm workers in the Gaza Strip.

The result that a high proportion of farm workers were more aware of inhalational and dermal absorption of pesticides than other routes of exposure agrees with other studies which have found that most occupational exposure to pesticides occur from skin absorption and through inhalation.[22 23] The present investigation showed a moderate to low awareness among farm workers towards the fate of pesticide residues in soil, in air, on plants, and in groundwater. This level of knowledge could put farm workers at risk when contact is made with pesticide residues on plants, in soil, and in dust particles after spraying.

When the respondent farm workers were questioned about their knowledge regarding pesticide associated toxicity symptoms, most knowledge was of a burning sensation in the eyes/face, watering of eyes, cold/breathlessness/chest pain, itching/skin irritation, headache, and dizziness. Such knowledge suggests that farm workers experienced these symptoms in situ. Most of these symptoms are considered to be common manifestations of acetylcholinesterase inhibition.[24]

Regarding toxicity symptoms associated with pesticides, results show that common self reported toxicity symptoms among farm workers were burning sensation in the eyes/face, dizziness, cold/breathlessness/chest pain, itching/skin irritation, and headache. These findings require urgent prevention, intervention, and protection from the Ministry of Health and other non-governmental organisations. Similar data were reported in many countries, including the neighbouring ones.[25 26]

The majority of the interviewed farm workers knew that wearing protective gear can protect the body from the adverse health effects of pesticides, but no one took precautions unless they knew about the measures. As concluded by the interviewer, the reason for not using protective gear, among farm workers who knew the benefit of the gear, could be attributed to carelessness, discomfort, cost, or unavailability of protective devices. The present finding is inconsistent with the study from Sri Lanka and the USA.[27 28] In this study we did not explore why awareness does not necessarily translate into action, but this point needs further investigation and could be the subject of future research.

The current investigation shows that the percentage of the interviewed farm workers who were against the use of pesticides was higher than those who agreed with pesticide use. Lack of knowledge of the other alternatives for pest control was the justification for the continuous use of pesticides. In addition, a high percentage of the interviewed farm workers believed that their bodies could develop resistance against pesticides. This is not only the attitude of farm workers in the Gaza Strip, but also the attitude of farm workers in the West Bank.[29] Such attitudes may further encourage farm workers to be careless towards the use of protective measures.

Although a low percentage of the interviewed farm workers store pesticides in the home, this practice still puts children and adults at risk. In addition, the high percentage of interviewed farm workers who dispose of the empty containers on the garbage site or along the street could put the general population at risk. Such practice was considered to be one of the main problems associated with pesticide use and its management in developing countries.[30]

The prevalence of mixing two or more pesticides was high among the interviewed farm workers and correlated with the prevalence of self reported toxicity symptoms associated with pesticides. The synergistic effect of chemicals may contribute to this result.[31] Also, the use of different concentrations of pesticides was positively associated with the prevalence of self reported toxicity symptoms among farm workers in the Gaza Strip. Use of high concentrations of pesticides is common among farm workers in the Gaza Strip.[32]

According to the present data the younger farm workers reported the highest self toxicity symptoms. As concluded by the interviewer, the younger farm workers often express themselves better than older ones, who sometimes hesitate to complain. Further studies are required to investigate this. A pesticide environmental extension and public awareness programme for Palestinian farm workers, which we have already started,[33] will alleviate pesticide associated problems in the Gaza Strip.

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